

## CLAIMS

What is claimed is:

1. A polymer solution containing cross-linking agent, comprising:

a polysaccharide;

a cross-linking agent having at least one X group and at least one Y group, wherein at least one of said at least one X group is bonded to said polysaccharide, and at least one of said at least one Y group is hydrolyzed; the general formula of said cross-linking agent is  $X_m-Z-Y_n$ , wherein both m and n are integers,  $m \geq 1$ ,  $n \geq 1$  and

an acid solution, said acid solution dissolves said polysaccharide and catalyzes the hydrolyzed Y groups, so that the hydrolyzed Y groups dehydrate and combine with each other to form cross-linking structure.

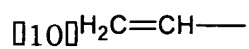
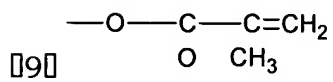
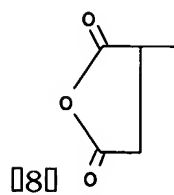
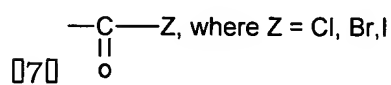
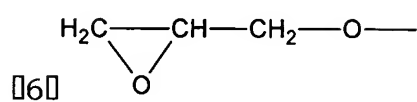
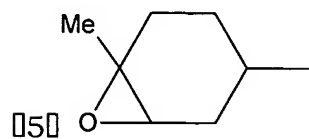
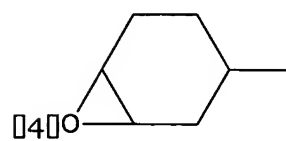
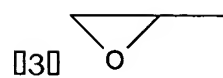
2. The polymer solution according to claim 1, wherein said polysaccharide is either any one or any combination of the following:

guar gum, guar ether, starch, starch ether, xanthan gum, dextran and chitosan.

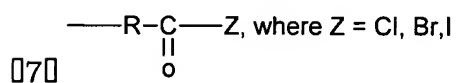
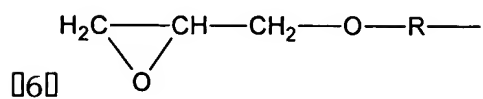
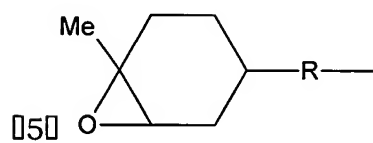
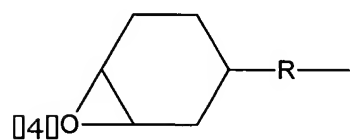
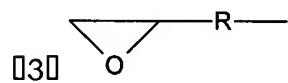
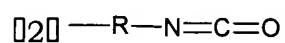
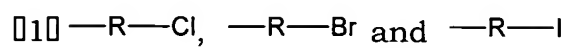
3. The polymer solution according to claim 1, wherein at least one said X group further comprises:

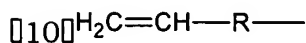
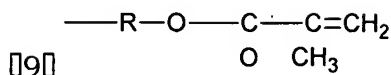
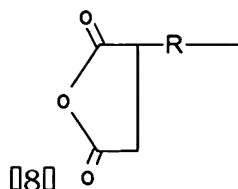
[1] Cl, Br and I

[2]  $-N=C=O$



4. The polymer solution according to claim 1, wherein at least one said X group further comprises:





R is an alkyl group.

5. The polymer solution according to claim 1, wherein at least one said Y group comprises alkoxide of 1 to 10 carbon atoms.

6. The polymer solution according to claim 1, wherein said Z group is silicon, tin, titanium, or zirconium.

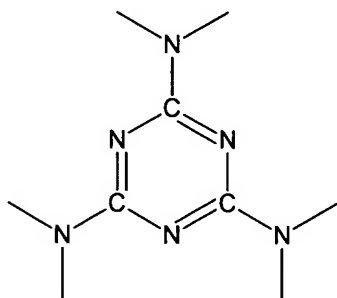
7. The polymer solution according to claim 6, wherein said cross-linking agent further comprises 3-glycidoxypentyl-trimethoxysilane [GPTMS].

8. The polymer solution according to claim 7, wherein the content of GPTMS is about 0.5 wt% to 70 wt% of said polysaccharide.

9. The polymer solution according to claim 1, wherein said Z group bonds to at least one alkyl group.

10. The polymer solution according to claim 1, wherein said Z group is a group containing nitrogen atoms.

11. The polymer solution according to claim 10, wherein said nitrogen atoms-containing group further comprises a structure as follows:



12. A method for forming a membrane having cross-linking structure, comprising:

providing a polysaccharide;

dissolving said polysaccharide by an acid solution for forming a feed;

providing a cross-linking agent having at least one X group and at least one Y group, wherein at least one of said at least one X group is bonded to said polysaccharide, and at least one of said at least one Y group is hydrolyzed; the general formula of said cross-linking agent is  $X_m-Z-Y_n$ , wherein both m and n are integers,  $m \geq 1$ ,  $n \geq 1$  and

mixing said feed and said cross-linking agent to form a casting solution, wherein at least one of said at least one X group of said

cross-linking agent is bonded to a specific functional group of said polysaccharide, and at least one of said at least one Y group is hydrolyzed to form a hydroxyl group; and

performing a membrane fabricating process by said casting solution for forming a membrane having cross-linking structure, wherein the acid in said casting solution catalyzes the hydroxyl groups, so that the hydroxyl groups dehydrate and combine with each other to form said cross-linking structure.

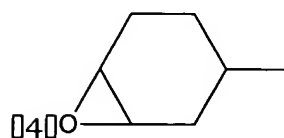
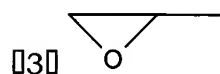
13. The method according to claim 12, wherein said polysaccharide is either any one or any combination of the following:

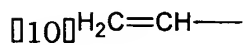
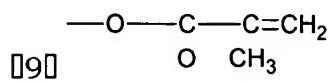
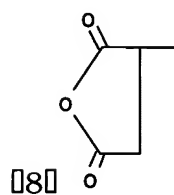
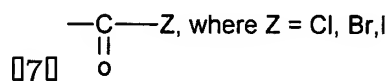
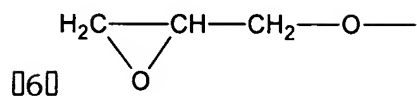
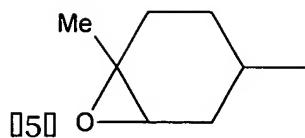
guar gum, guar ether, starch, starch ether, xanthan gum, dextran, chitosan and their combination.

14. The method according to claim 12, wherein at least one said X group further comprises:

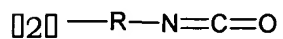
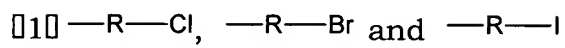
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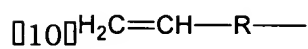
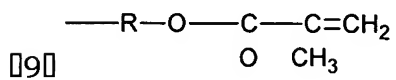
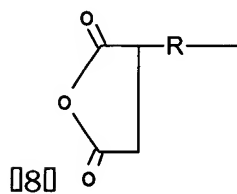
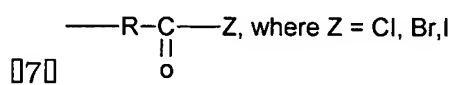
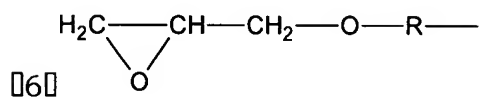
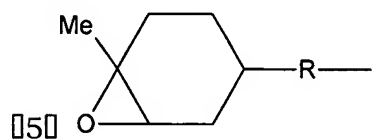
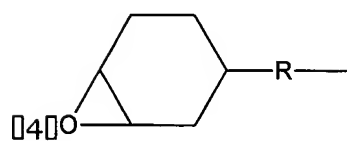
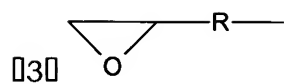
[2]  $\text{—N=C=O}$





15. The method according to claim 12, wherein at least one said X group further comprises:







R is an alkyl group.

16. The method according to claim 12, wherein at least one said Y group comprises alkoxide of 1 to 10 carbon atoms.

17. The method according to claim 12, wherein said Z group is silicon, tin, titanium, or zirconium.

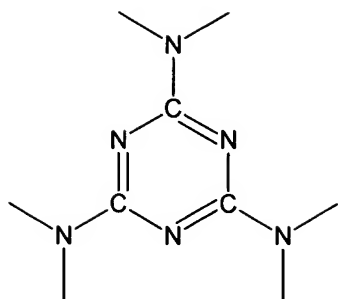
18. The method according to claim 17, wherein said cross-linking agent further comprises 3-glycidoxypyrpyl-trimethoxysilane [GPTMS].

19. The method according to claim 18, wherein the content of GPTMS is about 0.5 wt% to 70 wt% of said polysaccharide.

20. The method according to claim 12, wherein said Z group bonds to at least one alkyl group.

21. The method according to claim 12, wherein said Z group is a group contains nitrogen atoms.

22. The method according to claim 21, wherein said nitrogen atoms-containing group further comprises a structure as follows:



23. The method according to claim 12, wherein said specific functional group is amine, hydroxyl or carboxyl.

24. The method according to claim 12, when said polysaccharide is chitosan, at least one said X group of said cross-linking agent bonds to the amine group of chitosan.

25. The method according to claim 12, wherein said membrane fabricating process further comprises a temperature raising process to accelerate the hydrolysis of the Y groups and the dehydrating –combining reaction, so as to form said membrane having cross-linking structure.

26. The method according to claim 25, wherein said temperature raising process comprises at least one heating step wherein after each heating step, the temperature is remained for a period of time before another heating step is performed.

27. The method according to claim 25, when said polysaccharide is chitosan, the temperature range of said temperature raising process is

100 to 1700.

28. The method according to claim 12, wherein a fixation process is performed after said membrane fabricating process, and said fixation process comprises:

performing a neutralization process by a alkaline solution for neutralizing said membrane having cross-linking structure and a by-product of neutralization is formed after said neutralization process;

removing said by-product of neutralization by a cleaning agent from said membrane having cross-linking structure; and

performing a drying process for removing said cleaning agent from said membrane having cross-linking structure.

29. The method according to claim 12, wherein an acid-removing process is performed after said membrane fabricating process, and said acid-removing process comprises:

removing the acid by a cleaning agent from said membrane having cross-linking structure; and

performing a drying process for removing said cleaning agent from said membrane having cross-linking structure.

30. A material having cross-linking structure, comprising:

a modified substrate containing chitosan; and

a plurality of bridges formed on said modified substrate, wherein said plurality of bridges bond to the amine group of chitosan, and said plurality of bridges bond to each other so as to form the cross-linking structure; said plurality of bridges are formed by a cross-linking agent

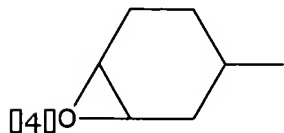
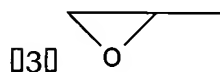
having at least one X group and at least one Y group, wherein at least one said X group can bond to chitosan, and at least one said Y group can be hydrolyzed, so that the hydrolyzed Y groups combine each other to form said plurality of bridges; the general formula of said cross-linking agent is  $X_m-Z-Y_n$ , wherein both m and n are integers,  $m \geq 1$ ,  $n \geq 1$ .

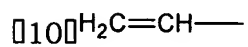
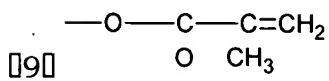
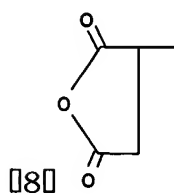
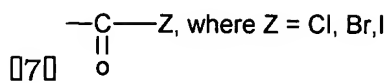
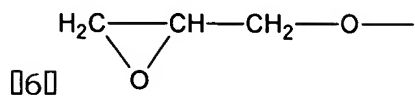
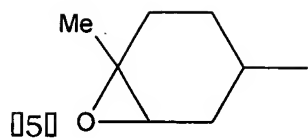
31. The material according to claim 30, wherein the method for forming said plurality of bridges is dehydrating -combining reaction by said cross-linking agent.

32. The material according to claim 30, wherein at least one said X group further comprises:

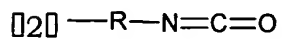
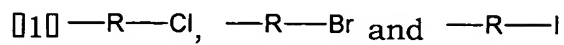
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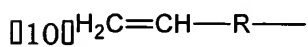
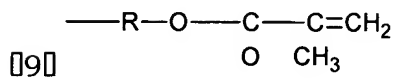
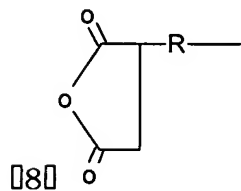
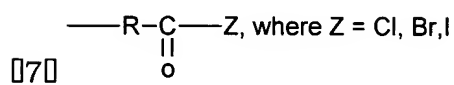
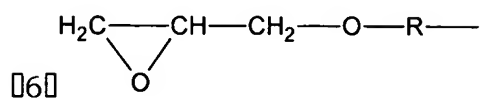
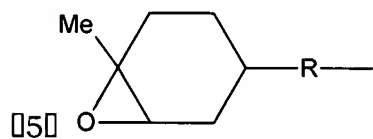
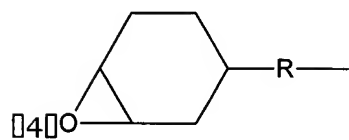
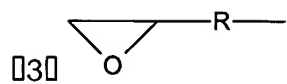
□2□  $-N=C=O$





33. The material according to claim 30, wherein at least one said X group further comprises:





R is an alkyl group.

34. The material according to claim 30, wherein at least one said Y group comprises alkoxide of 1 to 10 carbon atoms.

35. The material according to claim 30, wherein said Z group is silicon, tin, titanium, or zirconium.

36. The material according to claim 35, wherein said cross-linking agent further comprises 3-glycidoxypentyl-trimethoxysilane [GPTMS].

37. The material according to claim 36, wherein the content of GPTMS is about 0.5 wt% to 70 wt% of the chitosan.

38. The material according to claim 30, wherein said Z group bonds to at least one alkyl group.

39. The material according to claim 30, wherein said Z group is a group contains nitrogen atoms.

40. The material according to claim 39, wherein said nitrogen atoms-containing group further comprises a structure as follows:

